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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/615,915	07/10/2003	Yohei Yamazawa	227430US26	9540

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EXAMINER	
DHINGRA, RAKESH KUMAR	
ART UNIT	**PAPER NUMBER**
1763	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/615,915	YAMAZAWA ET AL.	
	Examiner	Art Unit	
	Rakesh K. Dhingra	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *03* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 November 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,4,6,11-16,18,19,26-30 and 41-44* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,4,6,11-16,18,19,26-30 and 41-44* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/22/06 has been entered.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 1 recites the limitation "the predetermined member" in line 20. There is insufficient antecedent basis for this limitation in the claim.

Response to Arguments

Applicant's arguments with respect to independent claims 1, 3, 4, 10-13, and 26-29 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended claims 1, 12, 26 by adding new limitation "wherein the impedance setting section comprises:

> an impedance change unit connected to the first interconnection through a shunt, and
>
> a filter disposed on the shunt between the first interconnection and the impedance change unit and configured to select a higher harmonic as a resonance target and to cut a component having the fundamental frequency of the RF power." Applicant has also added new dependent claim 44.

Reference by Kubota (JP 2000-286235) when combined with Raoux et al (US Patent No. 7,004,107) and Hilliker (US Patent No. 6,631,693) reads on limitations of amended claims 1, 12, 26. Accordingly independent claims 1, 12, 26 have been rejected under 35 USC 103 (a) as explained below. Further dependent claims 3, 4, 6, 10, 11, 13-16, 18, 19, 27-30 and 41-44 have also been ejected under 35 USC 103 (a) as explained below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3, 4, 11-13, 18, 19, 26, 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693).

Regarding Claim 1: Raoux et al teach a plasma apparatus (Figures 1, 5, 7, 11) that includes: an airtight process chamber 30 that accommodates a wafer 36;

a gas supply system 89 and an exhaust system 88;

first and second electrodes 40, 32;

high & low frequency power sources 12, 17, high frequency matching unit 13, a processor 85 and impedance setting section (impedance tuner 108 – like an impedance change unit, and an impedance probe 110) connected through an interconnection to a predetermined member to be electrically coupled to plasma. Roux et al also teach that impedance probe 110 is connected both to upper electrode side and to the lower electrode side and is also in communication with the processor 85 and thus based upon input from the impedance probe 110, processor 85 can adjust impedance setting. Raoux et al further teach that the impedance setting section (impedance tuner 108 and impedance probe 110 with processor 85) can be configured to set a previously defined value of plasma impedance (could include backward impedance also) and in case of variation, the plasma impedance could be adjusted using impedance tuner 108 through a processor 85 (controller) that executes a system control software program stored in memory 86. It would thus be obvious to adjust the impedance value based upon impedance information from the impedance probe 110. Roux et al additionally teach that impedance tuner 108 (impedance setting section) can comprise a variable capacitor (Figure 11) or even a parallel LC circuit. Roux et al also teach that by varying the capacitance of capacitor 20 (Figure 5) it is possible to adjust the frequency and amplitude of harmonics. Roux et al further teach a low pass filter 16 connected to the pedestal 32 for shielding low RF source from the high frequency RF source (column 6, lines 10-25 and column 8, line 62 to column 9, line 40 and column 10, lines 45-65 and column 18, lines 12-62).

Roux et al teach that impedance tuner is a variable capacitor but do not do not explicitly teach that the impedance control includes control of backward impedance also. Further, Roux et al teach that impedance tuner 108 (impedance change unit) is connected as a shunt connection to pedestal 106 (a first interconnection) but do not explicitly teach that a filter is disposed on the shunt between the first

interconnection and the impedance change unit and configured to select a higher harmonic as a resonance target and to cut a component having the fundamental frequency of the RF power.

Kubota et al teach a plasma apparatus (Figures 1-6) which performs a plasma process on a target substrate by using plasma, comprising an airtight process chamber 1, a showerhead 16 and lower electrode 2 (first and second electrodes) arranged in the process chamber to oppose each other, an RF power supply 11 connected to the second electrode 2 through a first interconnection, a matching circuit 10 arranged on the first interconnection and configured to serve to automatically perform input impedance matching relative to the RF power and an impedance adjustment device 30 (includes variable capacitor 40) provided in addition to the matching circuit and to set a backward-direction impedance as an impedance against an RF component, and capable of changing a value of the backward-direction impedance (paragraph 0011-0013, 0016-0021, 0022-0024, 0030-0035, 0045).
Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use impedance adjustment device as taught by Kubota et al in the apparatus of Roux et al to avoid abnormal discharge in the return path of the high frequency current supplied to the lower electrode (paragraph 0010).

Roux et al in view of Kubota et al teach that impedance tuner 108 (impedance change unit) is connected as shunt connection to pedestal 106 (a first interconnection) but do not explicitly teach that a filter is disposed on the shunt between the first interconnection and the impedance change unit and configured to select a higher harmonic as a resonance target and to cut a component having the fundamental frequency of the RF power.

Hilliker teaches a plasma apparatus (Figures 2, 6) wherein a reactor 104 is connected with a filter network 102, through a matching network 103. Hilliker further teaches that filter network 102 isolates RF generator 101 from the plasma load and also stabilizes the voltage waveform seen by the plasma in the reactor. Hilliker also teaches that the filter circuit comprises parallel resonant circuit and can allow

frequencies of interest (includes higher harmonics as) to be delivered to plasma and absorb the unwanted frequencies (including fundamental frequency of RF power). Hilliker additionally teach that location of filter circuit 202 can be varied with respect to impedance matching elements 111 depending upon the type of applications [column 1, lines 56-66, column 3, lines 1-65 and column 8, line 25 to column 9, line 5).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use filter circuit connected with impedance change unit as taught by Hilliker in the apparatus of Roux et al in view of Kubota et al to isolate the RF generator from the effects on non-linear loading presented by the plasma and obtain desired process results by using frequencies of interest.

Regarding Claims 3, 4: Raoux et al teach that apparatus enables preset control profiles for each process can be stored in the software program in advance and the apparatus results in improved uniformity and stability of the plasma process on the target substrate (Column 9, lines 40-55 and Column 21, line 60 to Column 22, line 15).

Regarding Claim 11: Rouax et al teach the value of the input impedance can be set (configured) and controlled as per process limitation (Column 18, lines 30-65).

Further it has been held in courts (Case Law) as follows:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable such as through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claims 12, 26: Rouax et al in view of Hilliker teach all limitations of the claim (as explained above under claim 1), including impedance setting using impedance setting section comprising of impedance probe 110, impedance tuner 108 and controller (processor) 85. Further Rouax et al teach that harmonics developed in the plasma can be tuned by suitabily adjusting the value of matching capacitor 20 {like part of an impedance setting section} (Figure 1 and Column 9, line 55 to Column 10, line 10).

Additionally Hilliker also teaches that the filter circuit can allow frequencies of interest (includes higher harmonics as) to be delivered to plasma and absorb unwanted frequencies (including fundamental frequency of RF power).

Regarding Claim 13: Rouax et al teach that the impedance tuner 108 is connected to lower electrode (Figures 5, 11).

Regarding Claim 18: Hilliker teaches that filter circuits (Figures 1) have a resistance (that is impedance, since reactive component is very low) of 50 ohm to enable dissipate energy at other than desired frequencies (Column 4, lines 26-53).

Regarding Claims 19: Hilliker teaches that Filter circuit 601 (Figure 6) include a high pass filter 631 and a low pass filter 621 which can be set to cut any desired frequency including fundamental frequency component (Column 8, lines 25-67).

Regarding Claim 27: Rouax et al teach the value of the input impedance can be set (configured) and controlled as per process limitation (Column 18, lines 30-65).

Further it has been held in courts (Case Law) as follows:
It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable such as through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Claims 6, 16, 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) as applied to Claims 1, 12, 26 and further in view of Collins et al (US Patent No. 6,252,354).

Regarding Claims 6,16, 44: Raoux et al in view of Kuboda et al and Hilliker teach all limitations of the claim including that variable capacitor of the impedance tuner 108 (Raoux et al) enables impedance

to be automatically adjusted (continuously varying element) in response to from impedance probe 110 to enable control impedance.

Raoux et al in view of Kuboda et al and Hilliker do not teach impedance control stepwise by switching a plurality of fixed elements.

Collins et al teach an apparatus (Figures 5, 6) that uses plurality of switches 520, 520' which can be closed in different combinations to provide choice of resistive matching ranges to facilitate impedance matching and that various inductive and capacitive elements may be fixed or variable (Column 10, line 52 to Column 11, line 37).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use stepwise control of impedance as taught by Collins et al in the apparatus of Raoux et al in view of Kuboda et al and Hilliker to provide further optimization of plasma parameters.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) as applied to Claim 12 and further in view of Shan et al (US Pub. No.2001/0009139).

Regarding Claim14: Raoux et al in view of Kuboda et al and Hilliker teach all limitations of the claim except that predetermined member is focus ring.

Shan et al teach an apparatus (Figure 2) that has matched RF power connected to Process kit (focus ring) 220 [Paragraphs 0029, 0035, 0040].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to select focus ring as predetermined member as taught by Shan et al in the apparatus of Raoux et al in view of Kuboda et al and Hilliker to improve plasma uniformity (Paragraph 0011).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) as applied to Claim 12 and further in view of Hendricks et al (US Patent No. 4,340,461).

Regarding Claim 15: Raoux et al in view of Kuboda et al and Hilliker teach all limitations of the claim except that predetermined member is rectifying (baffle) plate.

Hendericks et al teach an apparatus that has a conductive baffle (rectifying) plate 41 (Figures 1, 2) connected to anode (upper electrode) 3 which is connected to RF power source [Column 4, lines 1-50 and Column 7, lines 39-45]. As already explained above, Sato et al in view of Patrick et al and Parson teach plasma system where one of the electrodes is connected to matching network and impedance setting section with a controller for matching of impedance.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use baffle plate as predetermined member and connected to RF source (through one of the electrode-anode) as taught by Hendericks et al in the apparatus of Raoux et al in view of Kuboda et al and Hilliker to increase process uniformity (Column 6, lines 3-11).

Claims 28, 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) as applied to claim 26 and further in view of Sato et al (US Patent No. 6,199,505).

Regarding Claim 28: Raoux et al in view of Kuboda et al and Hilliker teach all limitations of the claim including parallel electrodes 40, 32 disposed in a reactor chamber 30, with a RF supply 13 connected to upper electrode 40 at a first interconnection and another power supply 17 connected to lower electrode 32 at a second interconnection.

Raoux et al in view of Kuboda et al and Hilliker do not teach second matching circuit connected to the second electrode at a second interconnection.

Sato et al teach an apparatus (Figures 1,3) which performs a plasma process on a target substrate 66 by using plasma, comprising an airtight process chamber 40a;

first and second electrodes 78, 54a arranged in the process chamber, and first and second RF power supplies 86, 62 connected to the first and second electrodes through matching circuits 84, 60 supply RF power, the matching circuits serving to perform input impedance matching relative to the RF power (Column 4, lines 40-63 and Column 8, lines 5- 50);

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use second matching circuit for connection between second RF supply and the lower electrode as taught by Sato et al in the apparatus of Raoux et al in view of Kuboda et al and Hilliker to obtain independent matching between the low frequency RF power supply and the plasma load.

Regarding Claim 29: Sato et al teach that frequency of first RF power source 86 is higher (30-300 MHz) than that of second RF power source 62 (0.3 to 30 MHz) [Column 8, lines 30-40).

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) and Sato et al (US Patent No. 6,199,505) as applied to Claim 29 and further in view of Nakano et al (US Patent No. 6,270,618).

Regarding Claim 30: Raoux et al in view of Kuboda et al, Hilliker and Sato et al teach all limitations of the claim except frequency of first RF power being lower than that of second RF power.

Nakano et al teach an apparatus (Figure 11) that has first RF power supply 1 (13.56 MHz) connected to upper electrode 4 and second RF power supply 15 (100

MHz) connected to susceptor 8 and where the system has a band eliminator 61b that can be set to resonance to select only a specific frequency to be supplied to susceptor (Column 1, lines 10-65).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use frequency configuration for the electrodes as taught by Nakano et al in the apparatus of Raoux et al in view of Kuboda et al, Hilliker and Sato et al to enable generate plasma as per process limitations.

Claims 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raoux et al (US Patent No. 7,004,107) in view of Kubota et al (JP 2000-286235) and Hilliker (US Patent No. 6,631,693) as applied to claims 1, 12, 26 and further in view of Shannon et al (US PGPUB No. 2003/0192475).

Regarding Claims 41-43: Raoux et al in view of Kuboda et al and Hilliker teach all limitations of the claim as explained above including an impedance setting section being configured to set a desired backward impedance value.

Roux et al in view of Hilliker do not teach a circuit defining the backward impedance to resonate with at least one of higher harmonics.

Shannon et al teach a plasma apparatus (Figures 1-5) that includes a chamber 100, with a RF power supply 132 coupled to lower electrode 110 through a matching network 134. Shannon et al further teach that by using a separate shunt circuit 502/504 coupled to a probe 506 (like an impedance setting section) and by suitably adjusting impedance of related chamber structures like feed line to cooling plate 310, the higher harmonics can resonate and harmonic energy can be shunted to ground (Paragraphs 0020, 0022-0026).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use separate circuit for shunting the harmonic energy to ground as taught by Shannon et al in the apparatus of Raoux et al in view of Kuboda et al and Hilliker to improve plasma uniformity (Paragraph 0026).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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